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	Narrow.	Double.	Triple.
Red	16 yards	28 yards	40 yards.
Yellow	24 “	34 “	60 “
Green	35 “	56 “	72 “

These strips were not measured very accurately, but the following were carefully measured : —

	Narrow.	Double.	Triple.
Red	18 paces	23 paces	34 paces.
Yellow	29 “	43 “	56 “
Green	34 “	51 “	67 “

We see from the above table that when the strips are three times as wide, the distance at which they can be seen is just about double.

My conclusions therefore are as follows : —

1. Herbert Spencer's instance cannot be accepted as an evidence of heterogeneity.
2. Distance is an important element in our perception of color.
Every one may be said to be color-blind in reference to the stars.
3. The three factors, distance, intensity, and amount of surface from which the illumination proceeds, should be considered in the location of colored signal-lights.
4. Spectrum analysis of very faint stars does not aid us in determining their color, on account of the faintness of the lines.

NO. XXI.—SIMPLE APPARATUS FOR ILLUSTRATING PERIODIC MOTION.

BY JOHN TROWBRIDGE.

Presented Dec. 10, 1879.

THERE are many ways of showing Lissajous' experiments, and on many accounts the tuning-fork method is the best; but the apparatus is expensive and cannot be readily obtained. The following forms of apparatus can be made by any one at a trifling expense.

No. 1.—*Graphical Method.*

The apparatus represented in Fig. 1 draws the curves before an audience on the screen, and does not require a vertical lantern. A is

a plate of smoked glass which slides to and fro with a flat board $m n$. The latter moves in guides. d is a brass pointer, which presses against the smoked glass and moves to and fro at right angles to the direction of the board $m n$. Two eccentrics connected with the wheels L and E communicate the to and fro motions to the pointer d and the glass A .

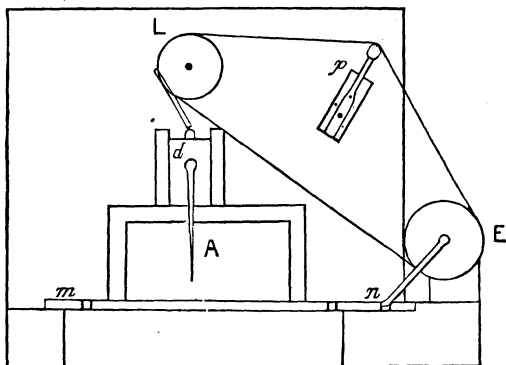


Fig. 1.

This glass is placed in front of the projecting lantern, and the curves of Lissajous are thus drawn on a screen before an audience. By changing the position of the eccentrics, the size of the curves can be modified at pleasure. A pulley, p , which slides in guides and can be clamped at any point, gives the connecting belt the requisite tension.

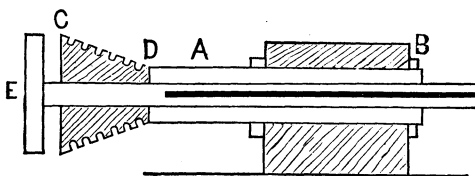


Fig. 2.

The rate of the movement at E can be changed by the device shown in Fig. 2. E is the face of the wheel to which the eccentric is attached. This face is affixed to the end of a slotted shaft which forms the centre of an axle, $A B$. At one end of this axle is the frustum of a cone, $C D$, which is provided with grooves for the leather string which serves for a belt to connect the arrangement at E with that at L , Fig. 1. By this arrangement, the same string can be used when the ratio of the wheels is changed; which is done by slipping both the

slotted axle A B and the slotted shaft connected with E until they are in position. The string is tightened by means of pulley at *p*, Fig. 1.

No. 2. — *Method by Beam of Light.*

Two wires are stretched at right angles to each other, and are maintained in vibration by electro-magnets, A and B, placed at the middle of their half-lengths, and by an elastic piece of wire, *w* and *n*, placed at their middle points. The stretched wires are provided with

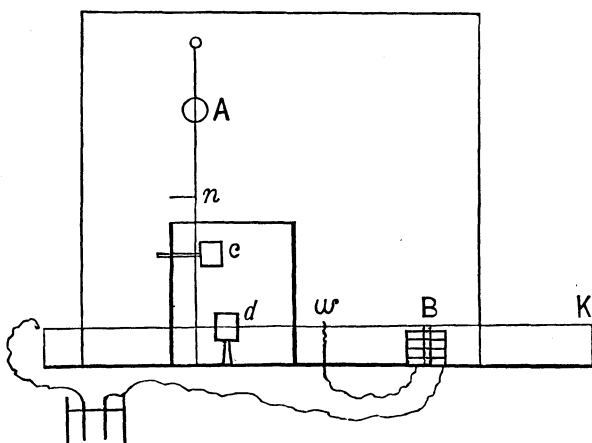


Fig. 3.

mirrors at *c* and *d*, which are steadied by flexible brass strips attached to the supports upon which the wires are stretched. The horizontal wire is kept in vibration by one battery, and the vertical by another. The process of tuning the wires can be illustrated to an audience by increasing the tension of the horizontal wire by means of a key at K. When the wires are tuned, a symmetrical and steady figure is produced on the screen, of very large size. The lime light is so placed as to allow the beam of light to fall on the mirror *d*, and then on the mirror *c*.